U.S. Forest Service

RESEARCH NOTE

CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS, OHIO R. D. LANE, DIRECTOR

CS-15 November 1963

PREDICTING OUTSLOPES OF SPOIL BANKS

When steep mountains are strip mined for coal the overburden is pushed downslope into standing trees and brush, usually without prior site preparation. Being able to predict, before mining is begun, just how much of the downslope will be covered by spoil material would be extremely helpful in planning the operation to protect roads, streams, fields, and similar features that lie below the area to be mined. Our strip-mine research scientists in Kentucky have developed a formula that makes such predictions possible.

Procedure

Strip-mine cross-section measurements were obtained at five mining operations in Harlan County, Kentucky. The Harlan coal seam was mined at three of the five operations while the high and low splint seams were mined at the other two. A wide range of sandstone-shale overburden was sampled on all three seams.

Cross-sectional measurements were taken at 50-foot intervals along the mined area, usually in groups of three to five. Highwall height, pit width, outslope length, angle of repose, and original slope angle were measured.

Results

The significant factors affecting the slope length of the spoil banks were the height of highwall (which is directly proportional to the volume excavated) and the angle of the original mountain slope. Original slope angles ranged between 16 and 43 degrees. The angle of repose for side cast overburden ranged between 34 and 40 degrees. The typical or "mean" cross-section had an original slope angle of 24 degrees (45 percent slope) and an angle of repose of 37 degrees (fig. 1).

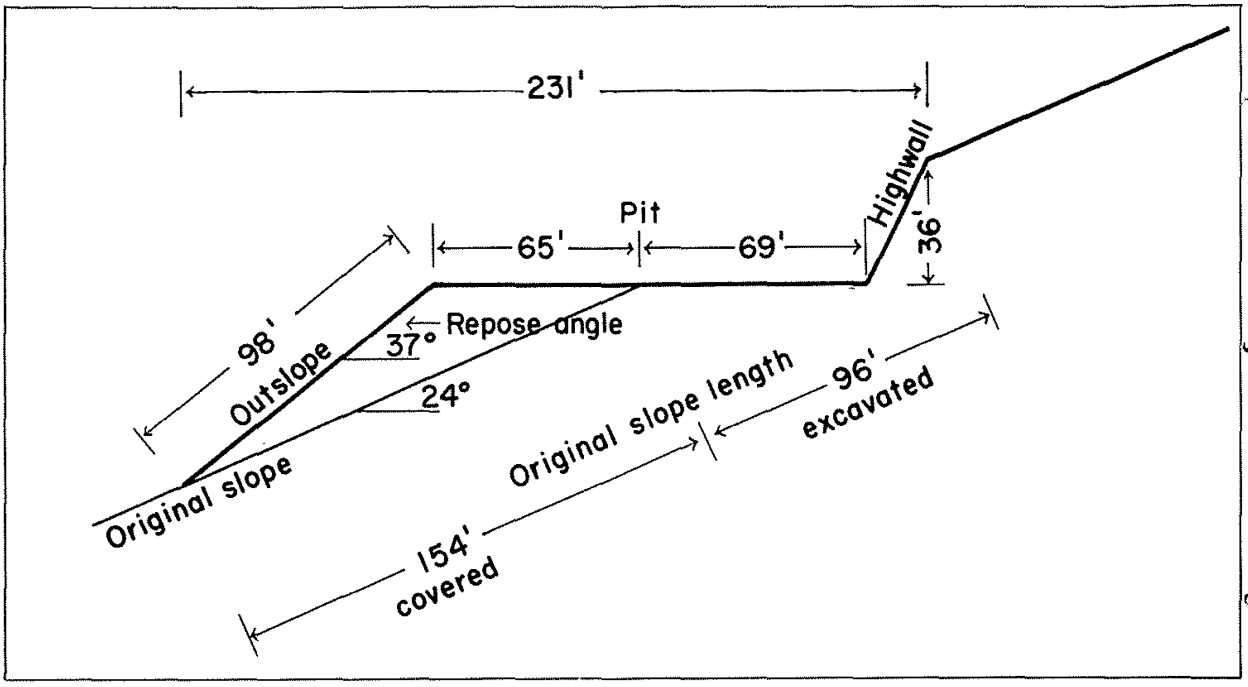

FIGURE 1.--Typical cross-section of contour strip mine (dimensions are means of 39 observations).

Using highwall height and original slope angle as independent variables, an equation was developed for predicting slope distance covered by spoil material (fig. 2). The standard error of estimate was found to be 33.9 feet and the correlation coefficient was 0.92. Curves for predicting the excavation portion of the original slope were also computed (fig. 3). The standard error of estimate was 9.1 feet and the correlation coefficient was 0.98.

The mean disturbed width (horizontal) of the strip mines observed in this study was found to be 231 feet. On this basis, each mile of contour strip mining disturbs 28 acres: 2 acres of highwall, 16 acres of pit, and 10 acres of outslope per mile.

Conclusions

This study has shown that the area of strip-mine disturbance can be predicted if the proposed highwall height and the original slope angle are known. A useful corollary to this is that if some land use or feature downslope from a proposed strip mine limits the amount of disturbed area that can be tolerated, the allowable depth of cut or height of highwall can be computed during the planning stage. In this way, the outslope can be restricted to the desired length and the property below protected.

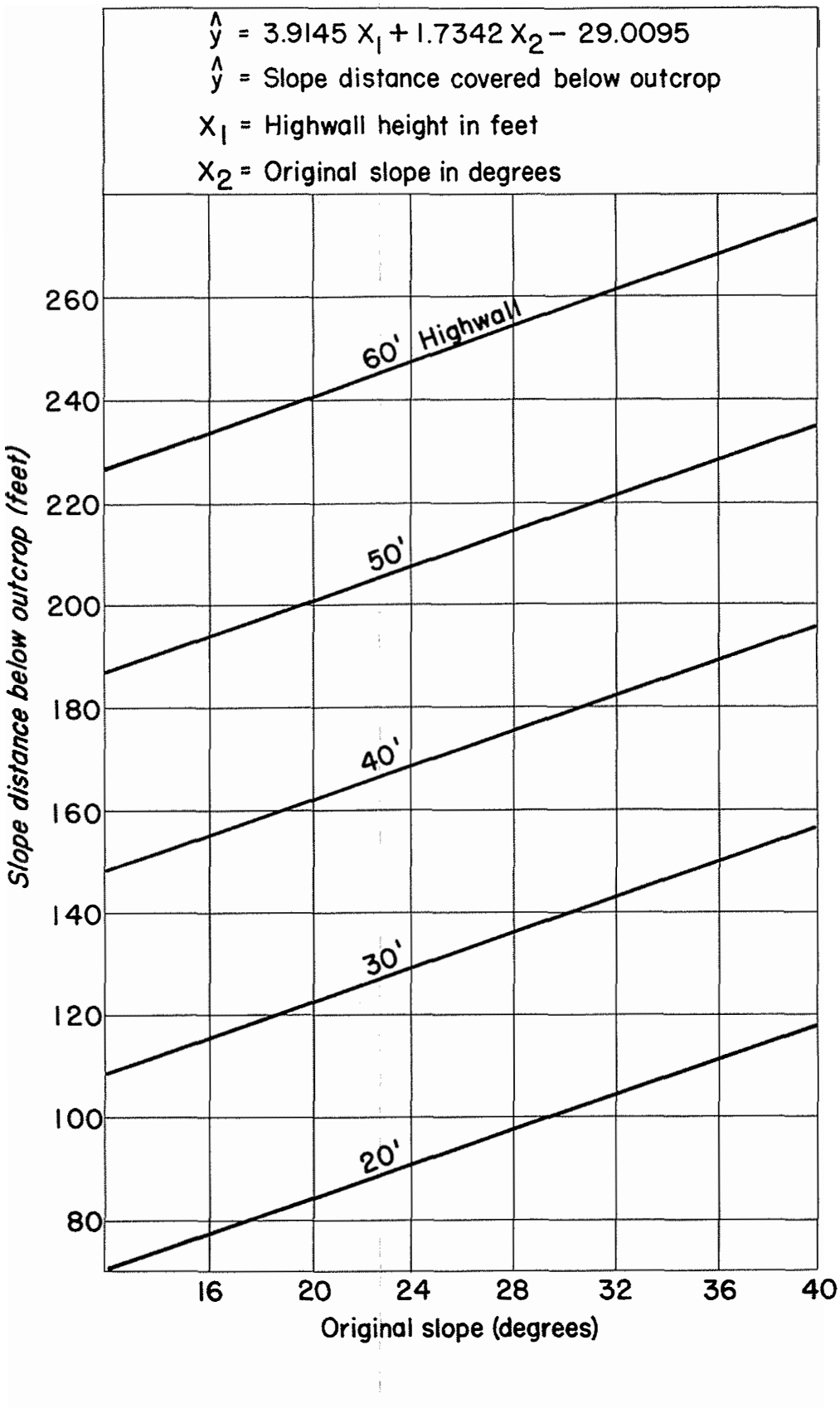

FIGURE 2.--Predicted slope distance covered below outcrop for various highwall heights.

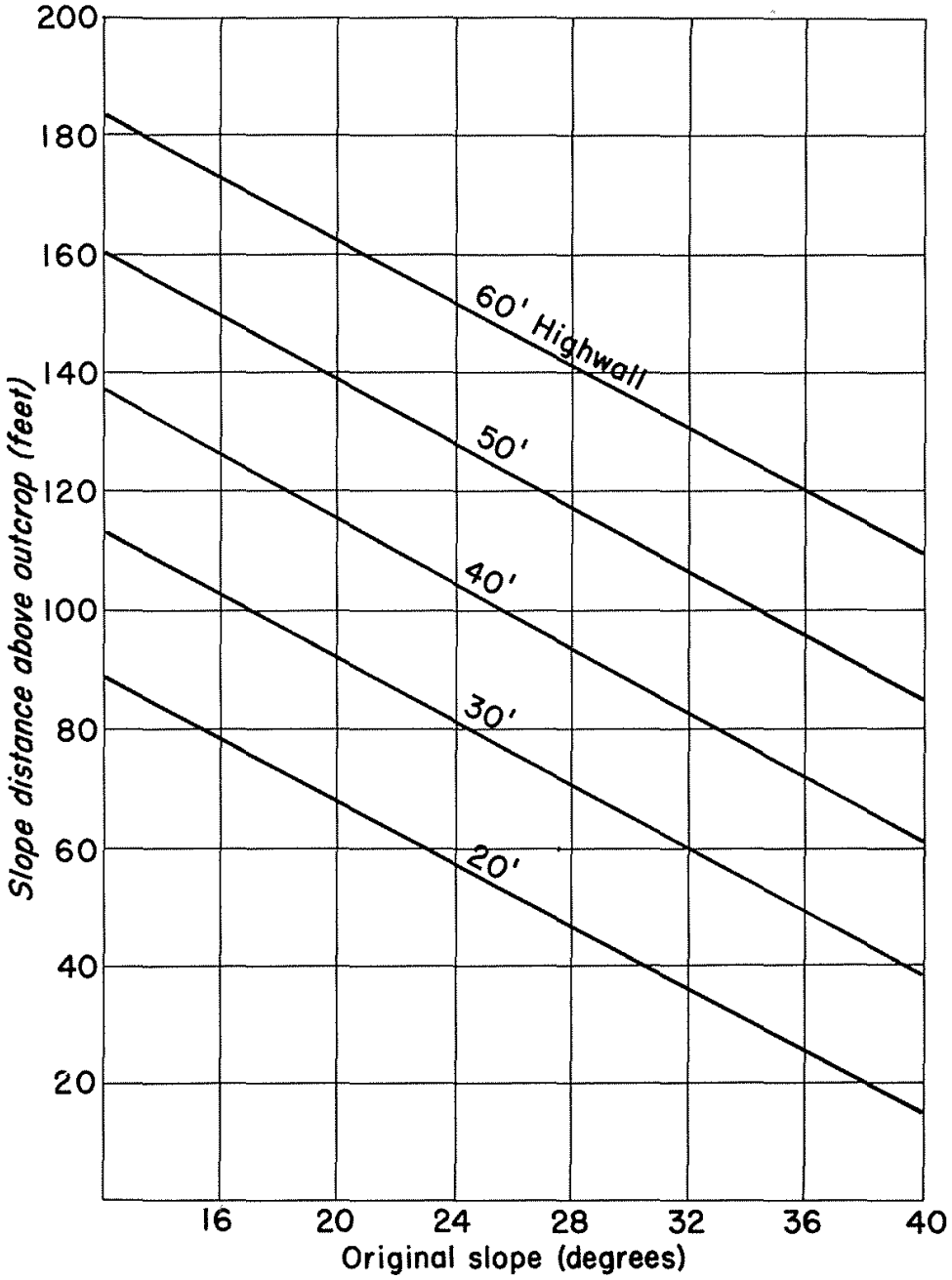

FIGURE 3.--Predicted slope distance excavated above outcrop for various highwall heights.

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